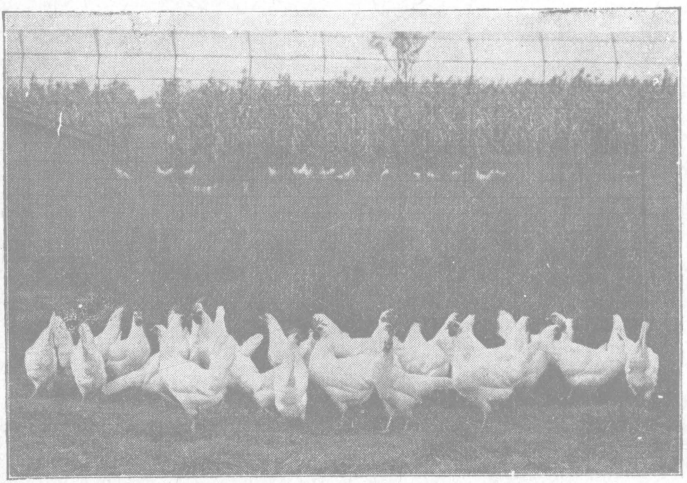
FEEDING EXPERIMENTS WITH LAYING HENS

OHIO
Agricultural Experiment Station

WOOSTER, OHIO, U. S. A., MARCH 1918

BULLETIN 322



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[1]In cooperation with the College of Agriculture, Ohio State University, Columbus.
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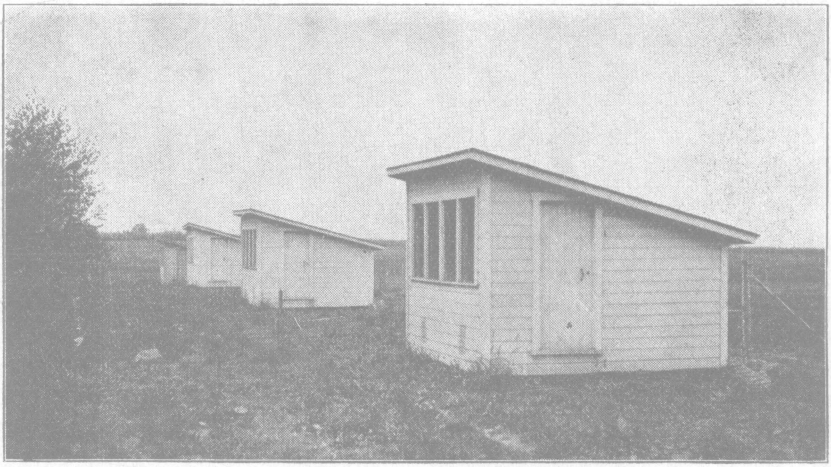

BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 322 MARCH, 1918

FEEDING EXPERIMENTS WITH LAYING HENS

W. J. BUSS

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The first three experiments reported in this bulletin are a continuation of similar work reported in Bulletin 291. The results reported here corroborate those presented in the former bulletin. Experiments IV, V and VI represent new lines of work which show some interesting results from the standpoint of the practical poultryman.

Experiments I*b*, I*c*, VI*a* and VI*b* were conducted at the Southeastern Test Farm, Carpenter, Ohio.

Prices used in calculations.—The following prices per hundredweight for feeds were used in the calculations in this bulletin:

Shelled corn	$2.00	Middlings	$1.75
Ground corn	2.10	Oilmeal	2.25
Wheat	3.00	Meat scrap	3.75
Ground wheat	3.10	Tankage	3.50
Oats	1.75	Oyster shells	.75
Bran	1.65	Grit	.75

No charge has been made for the range occupied by the various lots.

The feeds used in these experiments were of good quality. The meat scrap was guaranteed by the manufacturers to contain 50 percent and the tankage 60 percent of crude protein. The meat

scrap and tankage were of good quality, free from an excessive amount of hair, broken teeth and foreign material. Linseed oilmeal was old process, finely ground

The following prices for eggs per dozen for 4-week periods beginning approximately on the dates given, were used in calculations:

	Cents		Cents
January 1	39½	July 16	30½
January 29	35	August 13	33
February 26	27	September 10	36
March 26	25½	October 8	37½
April 23	27	November 5	33½
May 21	28½	December 3	37½
June 18	28		

It is impossible to use a scale of prices for commodities that will make the financial calculations in this bulletin applicable at various times in various localities in the State. They are used simply as a basis for comparison between the different lots rather than to show actual financial results at any given time. The amount of feed consumed per bird and per unit of product is of much more importance than the financial figures presented, because to these the poultryman may apply prices that prevail in his locality at any time and secure figures that will be applicable to his local conditions.

Method of feeding.—In all experiments reported in this bulletin, the proportions of feeds are by weight rather than by measure. Except with some lots in Experiment IV, the grain mixture was fed twice daily in equal parts. The mash mixture was fed dry in self-feeding hoppers. By regulating the amount of grain fed, an attempt was made to have the fowls consume half as much mash as grain. In most cases the hoppers were left open at all times. Sometimes, however, it became necessary to close them for a part of the time for some of the lots, because the fowls consumed too much mash while leaving some grain. All lots had constant access to hoppers containing oyster shells and grit. The hens were provided with a regular supply of water. No green feed aside from that secured in the yards was used.

Weighing fowls.—In all experiments the fowls were weighed individually at the beginning of the experiment and each fourth week thereafter, on the same day of the week and at the same time of day. The initial and final weights and gains or losses in weight of the hens are given only for those living at the close of the period under consideration.

Male birds in lots.—Male birds were kept in the various lots during the breeding seasons except in Experiment I*c*, first year of Experiment IV, Lot 3 in Experiment V and Experiment VI. In lots having 30 females or less, one male was used; in the other lots, two males. It was not practicable to feed the male birds separately, and hence no account has been taken of the feed consumed by them. This discrepancy, however, is very slight. In no case would it amount to more than one-half of 1 percent of the feed consumed, and with most lots the difference would be even less. In all experiments except Experiment V, the same number of male birds were kept in each lot; and the figures, with this one exception, for the lots in each experiment would be on the same basis. In Experiment V, a male bird was kept in each of Lots 1 and 2 for 65 days, but none was kept in Lot 3; slight allowance must therefore be made in this case to put the figures on a strictly comparable basis.

RANGE VS. CONFINEMENT

(A CONTINUATION OF EXPERIMENTS I*b* AND I*c* REPORTED IN BULLETIN 291)

EXPERIMENT I*b*

PLAN OF EXPERIMENT

Duration.—The data presented below were secured from November 28, 1915, to November 24, 1917, a period of 728 days.

Description of fowls.—The hens used were S. C. White Leghorns hatched in 1913. The reader is referred to Bulletin 291 for data showing the performance of these hens during their first 2 years of production. At the beginning of the second year of the tests as reported in this bulletin, 13 hens from the confined lot in Experiment I*c* were placed in the confined lot and 11 hens from the range lot in Experiment I*c* in the range lot. They were selected on the basis of egg production, being the highest-producing hens in those lots.

Quarters.—Each lot was kept in a house of the shed-roof type 10 by 24 feet in size. The lot on range had access to a plot of bluegrass containing 1.4 acres. Some other livestock was also pastured on this plot. The hens in confinement had a run 12 by 60 feet in size. This lot was covered with gravel and furnished no green feed.

Ration.—The grain mixture was composed of three parts of shelled corn and one part of wheat. The mash mixture was composed of four parts of ground corn, two parts of wheat bran, two parts of meat scrap, and one part of linseed oilmeal. The percentage of each feed in the ration when half as much mash as grain is

consumed, is as follows: Corn, 64.8 percent; wheat, 16.7 percent; bran, 7.4 percent; meat scrap, 7.4 percent; linseed oilmeal, 3.7 percent.

RESULTS OF EXPERIMENT

Mortality.—The number and percentage of hens that died during each period of the experiment are shown in Table 1.

TABLE 1.—MORTALITY

Lot	First period, Nov. 28, 1915, to Nov. 25, 1916			Second period, Nov. 26, 1916, to Nov. 24, 1917		
	Number at beginning	Mortality		Number at beginning	Mortality	
		Number	*Percent*		*Number*	*Percent*
Confined	44	8	18.2	49	9	18.4
On range	50	11	22.0	50	13	26.0

In this experiment, the mortality was somewhat higher in the range lot. During the first 2 years of the experiment, reported in Bulletin 291, the mortality was 17.5 and 12.3 percent, respectively, for the confined and range lots.

Weights.—Table 2 gives the average weight per hen at the beginning and close of each period. Only hens living at the close of the period are considered for that period.

TABLE 2.—AVERAGE WEIGHT AND GAIN OR LOSS PER HEN

Lot	Number living at close of period	Average initial weight	Average final weight	Average gain or loss (—) in weight
Nov. 28, 1915—Nov. 25, 1916 (364 days)				
		Pounds	*Pounds*	*Pound*
Confined	36	3.17	3.31	0.14
On range	39	3.17	3.23	.06
Nov. 26, 1916—Nov. 24, 1917 (364 days)				
Confined	40	3.22	3.13	—.09
On range	37	3.24	3.25	.01

The foregoing table indicates that there was little difference in the gain or loss in weight per fowl in the two lots.

Feed consumed.—Table 3 shows the amount and cost of feed, shells and grit consumed per hen.

TABLE 3.—AMOUNT AND COST OF FEED CONSUMED PER HEN

Lot	Average number in lot	Materials consumed per hen					Cost of feed per hen*
		Grain	Mash	Grain and mash	Shells	Grit	
		Nov. 28, 1915—Nov. 25, 1916 (364 days)					
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pound*	*Dollars*
Confined	39.82	39.15	18.86	58.01	1.24	0.18	1.34
On range	43.51	40.27	19.01	59.28	1.79	.23	1.37
		Nov. 26, 1916—Nov. 24, 1917 (364 days)					
Confined	43.76	39.10	17.66	56.76	1.10	.....	1.31
On range	43.17	39.47	17.77	57.24	1.48	.....	1.32

*See page 199 for prices used in calculations

In this experiment there was almost no difference in the amount of feed consumed per hen. This has been the case in all the experiments of this series.

Eggs produced.—The egg production and value of eggs per hen are shown in Table 4.

TABLE 4.—EGGS PRODUCED

Lot	First period, Nov. 28, 1915—Nov. 25, 1916			Second period, Nov. 26, 1916—Nov. 24, 1917		
	Average eggs per hen	Average value of eggs		Average eggs per hen	Average value of eggs	
		Per dozen	Per hen		Per dozen	Per hen
		Cents	*Dollars*		*Cents*	*Dollars*
Confined	100.2	29.10	2.43	91.3	28.8	2.19
On range	115.7	29.44	2.84	101.5	28.9	2.45

During the first period given in Table 4, the third year of production for the hens, the hens on range produced 15.5 percent more, and during the second period 11.2 percent more, than those in confinement.

In Table 5 are given figures showing the amount and cost of feed consumed per dozen eggs based on prices given on page 199.

TABLE 5.—FEED CONSUMED PER DOZEN EGGS

Lot	First period				Second period			
	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*
Confined	4.69	2.26	6.95	16.0	5.14	2.32	7.46	17.2
On range	4.18	1.97	6.15	14.2	4.66	2.10	6.76	15.6

During the first period the confined lot required 13 percent more and during the second period 10.4 percent more feed per dozen eggs than was required by the lot on range.

Summary.—Table 6 sets forth a summary of the important points in the preceding tables. Since some hens were added to each lot at the beginning of the second period, making the results of the two periods not altogether comparable, the summary is given in two parts to cover the two periods.

TABLE 6.—SUMMARY

Lot	Average number in lot	Mortality	Gain or loss (—) in weight per hen	Grain and mash consumed per hen	Eggs produced per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen[1]
Nov. 28, 1915—Nov. 25, 1916 (364 days)							
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollars*
Confined	39.82	18.2	0.14	58.01	100.2	6.95	1.09
On range	43.51	22.0	.06	59.28	115.7	6.15	1.47
Nov. 26, 1916—Nov. 24, 1917 (364 days)							
Confined	43.76	18.4	—.09	56.76	91.3	7.46	.88
On range	43.17	26.0	.01	57.24	101.5	6.76	1.13

[1] See page 199 for prices used in calculations.

EXPERIMENT Ic

PLAN OF EXPERIMENT

Duration.—The data secured below cover a period of 336 days from November 28, 1915, to October 28, 1916.

Description of fowls.—The hens used in this experiment were S. C. White Leghorns hatched in the spring of 1914. The first year's performance of these hens is shown in Bulletin 291.

Quarters.—Each lot of 79 hens occupied a pen 13 by 20 feet in size in a house of the half-monitor type, 20 by 60 feet in size. The lot on range had access to a plot of bluegrass containing approximately 2 acres. Other livestock was also pastured on this plot. The confined lot had access to an outside yard 13 by 60 feet in size. This yard was covered with gravel and furnished no green feed.

Ration.—The same ration used in Experiment I*b* was used in this experiment. (See page 201.)

RESULTS OF EXPERIMENT

Mortality.—The number and percentage of hens that died during this experiment are shown in Table 7.

TABLE 7.—MORTALITY

Lot	Number	Percent
Confined	14	17.7
On range	27	34.2

The reason for the much higher mortality in the range lot in this experiment is not apparent. It is probable that the comparatively heavy egg production of the range lot was in part at least responsible for the heavier mortality.

Weights.—Table 8 gives the average initial and final weights and average gain or loss per hen.

TABLE 8.—AVERAGE WEIGHT AND GAIN OR LOSS PER HEN

Lot	Number living at close of experiment	Average initial weight	Average final weight	Average gain or loss (—) in weight
		Pounds	*Pounds*	*Pound*
Confined	65	3.20	3.16	—0.04
On range	52	3.23	3.28	.05

Feed consumed.—The amount of feed and other materials consumed per hen, and the cost of these materials at the prices used in this bulletin are shown in Table 9.

TABLE 9.—AMOUNT AND COST OF FEED CONSUMED PER HEN

Lot	Average number in lot	Materials consumed per hen (336 days)					Cost of feed per hen*
		Grain	Mash	Grain and mash	Shells	Grit	
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pound*	*Dollars*
Confined	72.88	33.04	16.04	49.08	0.96	.....	1.13
On range	72.50	31.76	15.66	47.42	1.83	0.10	1.10

*See page 199 for prices used in calculations.

The average feed consumption per hen was slightly lower for the range lot than for the confined lot in this experiment. In all except one of the other experiments of this series the range lot consumed more feed than the confined lot. In no case has the difference been large. This suggests the importance of giving fowls kept for egg production an abundance of feed even when allowed free range rather than requiring them to depend upon the range for any considerable part of their sustenance.

Eggs produced.—The average egg production per hen and the average value of eggs per dozen and per hen are shown in Table 10.

TABLE 10.—EGGS PRODUCED

Lot	Average eggs per hen (336 days)	Average value of eggs	
		Per dozen	Per hen
		Cents	*Dollars*
Confined	72.6	28.7	1.74
On range	111.5	28.8	2.67

The hens on range produced 53.6 percent more eggs than those in confinement. This is a greater difference than has been secured in any of the other experiments of this series. During the first year of production of these hens the range lot produced 43.9 percent more eggs than the confined lot, as shown in the data reported in Bulletin 291. As explained there, the greater difference in egg production in favor of range with these hens, as compared with those in Experiments I*a* and I*b* is probably due to the fact that these hens were less vigorous than those used in the other experiments, indicating that fowls with low vitality will give relatively better returns if kept under the most favorable conditions.

Table 11 shows the amount and cost of feed consumed per dozen eggs on the basis of prices given on page 199.

TABLE 11.—FEED CONSUMED PER DOZEN EGGS

Lot	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*
Confined.	5.46	2.65	8.11	18.7
On range.	3.42	1.69	5.11	11.9

The hens in confinement consumed 58.7 percent more feed per dozen eggs than those on range.

Summary.—A summary of this experiment is shown in Table 12.

TABLE 12.—SUMMARY

Lot	Average number in lot	Mortality	Gain or loss (—) in weight per hen	Grain and mash consumed per hen	Eggs produced per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen[1]
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollars*
Confined,.	72.88	17.2	0.04	49.08	72.6	8.11	0.61
On range.	72.50	34.2	.05	47.42	111.5	5.11	1.57

*See page 199 for prices used in calculations.

VARIETY VS. SIMPLE RATIONS
MEAT SCRAP VS. TANKAGE
EXPERIMENT IIc

OBJECT OF EXPERIMENT

The object of this series of experiments is to determine whether so large a variety of feeds as has generally been recommended for laying hens is necessary if best results are to be secured, and whether the increase in production, if any, is sufficient to pay for the extra cost of feed, under usual market conditions, and to compensate the poultryman for his trouble in keeping a relatively small supply of many different feeds on hand. Experiments II*a* and II*b* of this series have been reported in Bulletin 291.

In addition to securing further data on these points, a lot was added to secure data regarding the relative efficiency of meat scrap and feeding tankage as sources of protein for laying hens. Tankage has usually been somewhat lower in price and contains about one-fifth more protein. Furthermore, on many farms tankage is used for hog feeding; and if it is a suitable feed for laying hens, the purchase of two similar feeds will be obviated.

PLAN OF EXPERIMENT

Duration.—This experiment was begun November 11, 1915, and closed November 7, 1917, thus covering a period of 728 days. The results are shown for two periods of 364 days each, with a summary for the entire experiment.

Description of fowls.—Four lots of 30 S. C. White Leghorns hatched April 13 to May 10, 1915, were used in this experiment. The various lots began producing eggs from October 21 to 29. Lots 1, 2, 3 and 4 had produced 29, 70, 25 and 43 eggs, respectively, at the time the experiment was begun.

Quarters.—Each lot was housed in a building of the shed-roof type, 10 by 12 feet in size, and had access to a yard 38 by 200 feet in size. Two of these yards were available for each lot, and the hens were changed from one yard to the other from time to time to prevent killing the grass. The yards occupied by Lot 1 provided a less abundant growth of grass than those occupied by the other lots. About half of each yard was closely planted to trees and provided an abundance of shade. The hens had access to these yards except when the ground was covered with snow.

Rations.—The following grain and mash mixtures were used in this experiment:

Lot 1. Grain—Shelled corn.
Mash—Ground corn, 8; meat scrap, 5.
Lot 2. Grain—Shelled corn.
Mash—Ground corn, 7; bran, 3; meat scrap, 5.
Lot 3. Grain—Shelled corn 3; wheat, 2; oats, 1.
Mash—Ground corn, 4; bran, 4; middlings, 4; oilmeal, 1; meat scrap, 3.
Lot 4. Grain—Shelled corn.
Mash—Ground corn, 7; bran, 3; tankage, 4.

The percentage of each feed in the ration when half as much mash as grain is consumed, is as follows:

Lot	Corn	Wheat	Oats	Bran	Middlings	Oilmeal	Tankage	Meat scrap
1	87.2	....	....	....	....	....	....	12.8
2	82.2	....	....	6.7	....	....	....	11.1
3	41.7	22.2	11.1	8.3	8.3	2.1	....	6.3
4	83.3	....	....	7.2	....	....	9.5	....

Mortality.—The number and percentage of hens that died in each lot during each period and during the entire experiment are shown in Table 13.

TABLE 13.—MORTALITY

Lot	First period, Nov. 11, 1915—Nov. 8, 1916		Second period, Nov. 9, 1916—Nov. 7, 1917		Entire experiment, Nov. 11, 1915—Nov. 7, 1917	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
1	2	6.7	1	3.6	3	10.0
2	3	10.0	4	14.8	7	23.3
3	4	13.3	3	11.5	7	23.3
4	2	6.7	2	7.1	4	13.3

In this experiment Lots 1 and 4 showed the lowest mortality. It is probable that factors other than the ration used influenced the mortality, although in Experiment II*a* of this series, Lots 2 and 3 showed a heavier mortality than Lot 1. In Experiment II*b*, however, Lot 3 showed the lowest mortality followed by Lots 1 and 2 in the order named. It would hardly be expected that there would be any difference between the rations fed to Lots 2 and 4 so far as their effect upon the rate of mortality is concerned, provided both tankage and meat scrap are of good quality.

Weights.—Table 14 gives the average weight and gain or loss in weight per hen for the four lots used in this experiment.

TABLE 14.—AVERAGE WEIGHT AND GAIN OR LOSS PER HEN

Lot	Number living at close of period	Average initial weight	Average final weight	Average gain or loss (—) in weight
	Nov. 11, 1915—Nov. 8, 1916 (364 days)			
		Pounds	*Pounds*	*Pound*
1	28	2.87	3.18	0.31
2	27	2.93	3.08	.15
3	26	2.89	3.08	.19
4	28	2.86	3.11	.25
	Nov. 9, 1916—Nov. 7, 1917 (364 days)			
1	27	3.20	3.06	—.14
2	23	3.09	3.00	—.09
3	23	3.10	3.02	—.08
4	26	3.08	2.93	—.15
Summary:	Nov. 11, 1915—Nov. 7, 1917 (728 days)			
1	27	2.89	3.06	.17
2	23	2.96	3.00	.04
3	23	2.93	3.02	.09
4	26	2.82	2.93	.11

There was not so much difference in the average gain in live weight per hen in this experiment as in the two preceding experiments of this series as reported in Bulletin 291.

Feed consumed.—The amount and cost of feed consumed per hen are given in Table 15.

TABLE 15.—AMOUNT AND COST OF FEED CONSUMED PER HEN

Lot	Average number in lot	Materials consumed per hen					Cost of feed per hen*
		Grain	Mash	Grain and mash	Shells	Grit	
		Nov. 11, 1915—Nov. 8, 1916 (364 days)					
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Dollars*
1	28.36	40.48	20.79	61.27	2.11	0.60	1.40
2	28.85	40.00	19.65	59.65	1.97	.50	1.32
3	27.21	46.98	21.91	68.89	2.41	.79	1.59
4	29.02	39.04	20.06	59.10	2.24	.61	1.28
		Nov. 9, 1916—Nov. 7, 1917 (364 days)					
1	27.89	38.81	19.04	57.85	1.36	.46	1.31
2	25.34	40.22	18.76	58.98	1.98	.53	1.30
3	24.39	41.78	20.46	62.24	2.48	1.05	1.44
4	26.94	38.70	20.07	58.77	2.13	.61	1.28
		Summary: Nov. 11, 1915—Nov. 7, 1917 (728 days)					
1	28.13	79.30	39.85	119.15	3.48	1.05	2.71
2	27.10	80.20	38.47	118.67	3.95	1.03	2.63
3	25.80	89.04	42.45	131.49	4.89	1.83	3.03
4	27.98	77.75	40.13	117.88	4.37	1.22	2.56

*See page 199 for prices used in calculations.

The amount of grain and mash consumed per hen was almost the same for Lots 1, 2 and 4. Lot 3 consumed 10.9 percent more feed per hen than an average of the other three lots. An advantage claimed by advocates of variety in the ration for laying hens is that it will increase the feed consumption. This series of experiments has shown that this claim is based on fact. It is essential, however, from the practical poultryman's point of view, to know whether this increased feed consumption will result in a corresponding increase in the egg production. The cost of feed on the basis of prices used in this publication was lowest with Lot 4, given the ration of corn, bran and tankage and highest with Lot 3, which received the variety ration. The relative cost of the different rations depends, of course, largely upon the prices of the various feeds. At prices that actually existed in the summer and fall of 1917, the variety ration would have proved more economical than the ration of corn and meat scrap. The feeder must consider the efficiency of the various rations as well as their cost if most economical results are to be secured from the poultry operations.

Eggs produced.—The average egg production and average value of eggs per hen and per dozen are given in Table 16.

TABLE 16.—EGGS PRODUCED

Lot	First period, Nov. 11, 1915—Nov. 8, 1916			Second period, Nov. 9, 1916—Nov. 7, 1917			Entire experiment, Nov. 11, 1915—Nov. 7, 1917		
	Average eggs per hen	Average value of eggs		Average eggs per hen	Average value of eggs		Average eggs per hen	Average value of eggs	
		Per dozen	Per hen		Per dozen	Per hen		Per dozen	Per hen
		Cents	*Dollars*		*Cents*	*Dollars*		*Cents*	*Dollars*
1	123.3	29.9	3.07	118.0	29.1	2.86	241.3	29.5	5.94
2	120.7	29.9	3.00	122.0	29.0	2.95	242 6	29.4	5.95
3	136.8	30.6	3.48	123.7	28.9	2.98	261.3	29.8	6.50
4	122.2	30.3	3.08	118.6	29.0	2.87	240.9	29.7	5.96

The average egg production per hen was almost the same for Lots 1, 2 and 4. Lot 3 produced 8.2 percent more eggs per hen than were produced by the average of the other three lots. Because the average number of hens was less in this lot than in the others, however, the total egg production of the lots was more nearly uniform. The total egg production for Lots 1, 2, 3 and 4, respectively, during the 2-year period of this experiment was 6,787, 6,574, 6,741, 6,739, a remarkably uniform production by lots fed such widely varying rations.

The amount and cost of feed consumed per dozen eggs are given in Table 17. Cost of feed includes the cost of shells and grit, but these materials are not included in the amount of feed.

TABLE 17.—FEED CONSUMED PER DOZEN EGGS

Lot	First period, Nov. 11, 1915—Nov. 8, 1916				Second period, Nov. 9, 1916—Nov. 7, 1917				Entire experiment, Nov. 11, 1915—Nov. 7, 1917			
	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*
1	3.94	2.02	5.96	13.6	3.95	1.94	5.89	13.3	3.94	1.98	5.92	13.5
2	3.98	1.95	5.93	13.1	3.96	1.84	5.80	12.8	3.97	1.90	5.87	13.0
3	4.12	1.92	6 04	13.9	4.05	1.98	6.03	13.9	4.09	1.95	6.04	13.9
4	3.83	1.97	5.80	12.6	3.92	2.03	5.95	12.9	3.87	2 00	5.87	12.8

Three of the four lots in this experiment consumed slightly less feed per dozen eggs during the second than during the first year, doubtless due to the fact that they gained in weight during the first year and lost in weight during the second. These figures indicate that hens of this kind should be kept at least 2 years for egg production. This is also shown by the average production per hen during the first and second years as well as the value of the eggs per hen. While the average value of the eggs produced per

hen, as shown in Table 16, was from 5 to 50 cents less the second year than the first, the cost of raising pullets to producing age would be considerably more than this.

Lot 3 required 2.5 percent more feed per unit of production than the other lots, a very small difference. With prices for feeds as used in this publication, the cost of feed per dozen eggs was 6.5 percent higher for Lot 3 than for the other lots.

Summary.—A summary of the results of this experiment for the entire time—November 11, 1915, to November 7, 1917 (728 days)—is given in Table 18.

TABLE 18.—SUMMARY

Lot	Average number in lot	Mortality	Gain in weight per hen	Grain and mash consumed per hen	Eggs produced per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen*
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollars*
1. . . .	28.13	10.0	0.17	119.15	241.3	5.92	3.23
2.....	27.10	23.3	.04	118.67	242.6	5.87	3.32
3..... .	25.80	23.3	.09	131.49	261.3	6.04	3.47
4....	27.98	13.3	.11	117.88	240.9	5.87	3.40

*See page 199 for prices used in calculations.

While the value of eggs above the cost of feed per hen for Lot 3 is highest as shown in the foregoing table, the profit from the entire lot is lowest for Lot 3 because of the higher mortality, and consequent smaller average number of hens. The figures for the entire lot for Lots 1 to 4, respectively, are $90.74, $90.20, $89.36, $94.98. This would indicate that on the basis of the results secured in this experiment and prices as used in these calculations—and they approximate the relative prices that prevail for the different feeds in normal times—the ration of corn and meat scrap, because of its simplicity, necessitating the purchase of only meat scrap on farms where corn is available, would seem to be the logical one to use. If tankage of good quality is more readily available than meat scrap, it can probably be combined with corn to make a satisfactory ration. These results also point out the fallacy in the belief of many poultrymen that a large use of corn in the ration, especially in summer, is undesirable because of its so-called "heating" properties.

VARIOUS AMOUNTS OF PROTEIN

EXPERIMENT IIIa

(A CONTINUATION OF EXPERIMENT III, BULLETIN 291)

OBJECT OF EXPERIMENT

The object of this series of experiments is to study the effect of rations containing approximately 10, 15 and 20 percent of crude protein upon the rate and economy of egg production.

PLAN OF EXPERIMENT

Duration.—The data presented below were secured from December 12, 1915, to October 14, 1916 (308 days), for the Leghorns and from December 12, 1915, to July 22, 1916 (224 days), for the Barred Rocks. The Barred Rocks were put on limited rations at this time to get them in better condition for breeders the following spring.

Description of fowls.—Three lots of Barred Plymouth Rocks and three lots of S. C. White Leghorns hatched in the spring of 1914 were used in this experiment.

Quarters.—Each lot of hens was housed in a pen 15 by 24 feet in size in a house of the half-monitor type 24 by 100 feet in size, and had access to a yard containing one-fourth of an acre. The yards were well covered with a sod of bluegrass and timothy. When there was snow on the ground the hens were confined to the house.

Rations.—The grain mixture for all lots was made up of three parts, by weight, of shelled corn, and one part of wheat. The mash mixtures for the different lots of each breed were composed of ground corn, bran and meat scrap in the following proportions:

Lot	Ground corn	Bran	Meat scrap
1	11	3	1
2	6	3	6
3	1	3	11

The percentage of each feed in the ration for each lot, when consuming half as much mash as grain, is shown below:

Lot	Corn	Wheat	Bran	Meat scrap
1	74.4	16.7	6.7	2.2
2	63.3	16.7	6.7	13.3
3	52.2	16.7	6.7	24.4

All lots had constant access to hoppers containing oyster shells and grit.

RESULTS OF EXPERIMENT

Mortality.—The number and percentage of hens that died in each lot are shown in Table 19.

TABLE 19.—MORTALITY

Lot	Barred Plymouth Rocks			S. C. White Leghorns		
	Number in lot at beginning of experiment	Mortality		Number in lot at beginning of experiment	Mortality	
		Number	*Percent*		*Number*	*Percent*
1	42	12	28.6	55	9	16.4
2	43	12	27.9	52	5	9.6
3	39	4	10.3	56	3	5.4

The mortality with the Barred Rocks was unusually heavy in the first year of this experiment as reported in Bulletin 291, and continued so with Lots 1 and 2 during the period covered by the foregoing data. The rate of mortality with Lot 3 of Leghorns continued lower than would be expected, but was about normal for Lots 1 and 2.

Weights.—The average weight and gain or loss in weight per hen are shown in Table 20.

TABLE 20.—AVERAGE WEIGHT AND GAIN OR LOSS PER HEN

Lot	Number living at close of period	Average initial weight	Average final weight	Average gain or loss (—) in weight
		Barred Plymouth Rocks		
		Pounds	*Pounds*	*Pound*
1	30	5.83	6.05	0.22
2	31	5.96	6.28	.32
3	35	5.90	5.72	—.18
		S. C. White Leghorns		
1	46	3.41	3.24	—.17
2	47	3.15	3.26	.11
3	53	3.22	3 21	—.01

Feed consumed.—Table 21 shows the amount and cost of feed consumed per hen.

TABLE 21.—AMOUNT AND COST OF FEED CONSUMED PER HEN

Lot	Average number in lot	Materials consumed per hen					Cost of feed per hen*
		Grain	Mash	Grain and mash	Shells	Grit	
		Barred Plymouth Rocks (Dec. 12, 1915—July 22, 1916, 224 days)					
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pound*	*Dollars*
1	33.62	32.77	15.12	47.89	1.33	0.60	1.07
2	37.17	32.90	16.26	49.16	1.53	.65	1.19
3	37.36	30.46	14.05	44.51	1.21	.38	1.15
		S. C. White Leghorns (Dec. 12, 1915—Oct. 14, 1916, 308 days)					
1	50.02	31.46	15.34	46.80	1.55	.53	1.05
2	49.81	33.80	16.21	50.01	1.42	.67	1.21
3	54.41	31.15	15.56	46.71	1.41	.59	1.22

*See page 199 for prices used in calculations.

The lot of each breed receiving the medium amount of protein consumed the most feed. This was also true of the Barred Rocks during the first year of the experiment, but Lots 2 and 3 of Leghorns consumed almost the same amount of feed per hen, with Lot 3 slightly in the lead.

Eggs produced.—The egg production and value of eggs per dozen and per hen are given in Table 22.

TABLE 22.—EGGS PRODUCED

Lot	Barred Plymouth Rocks Dec. 12, 1915 to July 22, 1916 (224 days)			S. C. White Leghorns Dec. 12, 1915 to October 14, 1916 (308 days)		
	Average eggs per hen	Average value of eggs		Average eggs per hen	Average value of eggs	
		Per dozen	Per hen		Per dozen	Per hen*
		Cents	*Dollars*		*Cents*	*Dollars*
1	61.4	29.7	1.52	83.5	28.7	2.00
2	63.6	29.1	1.54	93.6	28.7	2.24
3	48.5	28.5	1.15	77.1	28.7	1.85

As compared with Lot 2 of each breed, Lot 1 gave relatively better and Lot 3 relatively poorer results in egg production than they did during the first year.

The amount of grain and mash consumed and the cost of feed per dozen eggs produced are given in Table 23.

TABLE 23.—FEED CONSUMED PER DOZEN EGGS

Lot	Barred Plymouth Rocks Dec. 12, 1915—July 22, 1916				S. C. White Leghorns Dec. 12, 1915—Oct. 14, 1916			
	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*
1	6.40	2.95	9.35	20.9	4.52	2.20	6.72	15 1
2	6.20	3.07	9.27	22.4	4.33	2.08	6.41	15.5
3	7.53	3.47	11.00	28 4	4.85	2.42	7.27	18.9

The feed required per dozen eggs was almost the same with Lots 1 and 2 of each breed, while Lot 3 of Leghorns required approximately 10 percent and Lot 3 of Rocks 18 percent more feed per dozen eggs than Lots 1 and 2 of each breed, respectively. The figures in Table 23 showing feed required per dozen eggs for each breed are not comparable because records for the Leghorns were kept 12 weeks longer than for the Rocks during a period of relatively low production. However, even on the basis of the figures as they stand, with a distinct disadvantage to the Leghorns, the Rocks required 44.3 percent more feed per dozen eggs than the Leghorns. When compared for the same period the Rocks required 52.4 percent more feed per dozen eggs than the Leghorns. This furnishes further evidence in support of the statement that when egg production is the sole aim, one of the lighter breeds is likely to prove more profitable than one of the general purpose breeds. This is of especial importance in times of high-priced feeds.

Summary.—A summary of the foregoing data is given in Table 24.

TABLE 24.—SUMMARY

Lot	Average number in lot	Mortality	Gain or loss(—) in weight per hen*	Grain and mash consumed per hen	Eggs produced per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen*
Barred Plymouth Rocks (Dec. 12, 1915—July 22, 1916, 224 days)							
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollars*
1.	33.62	28.6	0.22	47.89	61.4	9.35	0.45
2.	37.17	27.9	.32	49.16	63.6	9.27	.35
3.	37.36	10.3	—.18	44.51	48.5	11.00	....
S. C. White Leghorns (Dec. 12, 1915—Oct. 14, 1916, 308 days)							
1.	50.02	16.4	—.17	46.80	83.5	6.72	.95
2.	49.81	9.6	.11	50.01	93.6	6.41	1.03
3.	54.41	5.4	—.01	46.71	77 1	7.27	.63

*See page 199 for prices used in calculations.

EXPERIMENT III*b*

PLAN OF EXPERIMENT

Duration.—This experiment was begun November 26, 1916. The data given below cover the period ending November 24, 1917 (364 days).

Description of fowls.—The fowls used were S. C. White Leghorn pullets. Ten in each lot were hatched February 22; 13, 16 and 12 in Lots 1, 2 and 3, respectively, were hatched April 20 and the rest May 3, 1916. There were 60 pullets in each lot at the beginning of the experiment. Prior to the time the experiment was begun, pullets in Lots 1, 2 and 3 had produced 156, 187 and 118 eggs, respectively. Of these the 10 pullets hatched February 22 produced the larger part, their production being 107, 144 and 72 in Lots 1, 2 and 3, respectively.

Quarters and rations.—These pullets occupied the same quarters and were given the same rations as the hens in Experiment III*a*, descriptions of which are given on page 212.

RESULTS OF EXPERIMENT

Mortality.—Table 25 shows the number and percentage of pullets that died in each lot.

TABLE 25.—MORTALITY

Lot	Number	Percent
1	4	6.7
2	9	15.0
3	10	16.7

The rate of mortality in Lots 1 and 2 was nearly the same as that of the pullets in Experiment III*a*, as given in Bulletin 291. The mortality for Lot 3, however, was much heavier in this experiment

than in the former one. It would be expected that the mortality of this lot in this experiment is more nearly normal than that shown in the former experiment.

Weights.—The average weight at the beginning and close of the experiment and the average gain per pullet are shown in Table 26.

TABLE 26.—AVERAGE WEIGHT AND GAIN PER PULLET

Lot	Number living at close of experiment	Average initial weight	Average final weight	Average gain in weight
		Pounds	*Pounds*	*Pound*
1	56	2.99	3.31	0.32
2	51	3.00	3.28	.28
3	50	3.02	3.08	.06

Feed consumed.—The amount and cost of feed consumed per pullet are given in Table 27.

TABLE 27.—AMOUNT AND COST OF FEED CONSUMED PER PULLET

Lot	Average number in lot	Materials consumed per pullet					Cost of feed per pullet*
		Grain	Mash	Grain and mash	Shells	Grit	
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pound*	*Dollars*
1	58.58	38.35	19.84	58.19	1.63	0.22	1.30
2	58.18	43.15	21.25	64.40	2.15	.35	1.56
3	55.66	42.91	20.65	63.56	1.86	.19	1.65

*See page 199 for prices used in calculations.

Each lot in this experiment consumed slightly more feed per pullet than in Experiment III*a*. (See Bul. 291, p. 210.) Lot 1 consumed 9.1 percent less feed per pullet than Lots 2 and 3. In the former experiment this difference was 10.9 percent.

Eggs produced.—Figures showing the average egg production and average value of eggs per dozen and per pullet are given in Table 28.

TABLE 28.—EGGS PRODUCED

Lot	Average eggs per pullet	Average value of eggs	
		Per dozen	Per pullet
		Cents	*Dollars*
1	93.6	30.6	2.39
2	139.6	30.6	3.57
3	128.5	30.2	3.23

Lot 2 produced 49.1 percent more eggs per pullet than Lot 1 and 8.6 percent more than Lot 3. The average egg production per pullet in Experiment III*a*, reported in Bulletin 291, was 92.5, 141.5 and 132.7 for Lots 1, 2 and 3, respectively. The average egg production secured in this experiment agrees closely with that secured in the former one.

The amount and cost of feed consumed per dozen eggs are shown in Table 29.

TABLE 29.—AMOUNT AND COST OF FEED CONSUMED PER DOZEN EGGS

Lot	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*
1.	4.92	2.54	7.46	16.6
2.	3.71	1.83	5.54	13.4
3.	4.01	1.93	5.94	15.4

Lot 1 consumed 34.7 percent more, and Lot 3, 7.2 percent more feed per dozen eggs than Lot 2. The cost of feed per dozen eggs at prices used in this bulletin was 23.9 percent higher for Lot 1 and 14.9 percent higher for Lot 3 than for Lot 2. The amount of feed requred per dozen eggs in the former experiment was 7.09, 5.17 and 5.57 pounds for Lots 1, 2 and 3. This is 0.37 pound less for each lot than the figures shown in Table 29 for this experiment.

Summary.—A summary of the results of this experiment is given in Table 30.

TABLE 30.—SUMMARY

Lot	Average number in lot	Mortality	Gain in weight per pullet	Grain and mash consumed per pullet	Eggs produced per pullet	Feed consumed per dozen eggs	Value of eggs less cost of feed per pullet*
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollars*
1	58.58	6.7	0.32	58.19	93.6	7.46	1.09
2	58.18	15.0	.28	64.40	139.6	5.54	2.01
3	55.66	16.7	.06	63.56	128.5	5.94	1.58

*See page 199 for prices used in calculations.

Note.—If skimmilk is available in sufficient amounts, it should be used instead of meat scrap in the ration for laying hens. The supply of meat scrap is insufficient to furnish all hens with as much protein as they should have to produce a maximum number of eggs.

DIFFERENT METHODS OF FEEDING

EXPERIMENT IV

OBJECT OF EXPERIMENT

The object of this experiment was to study the effect of six different methods of feeding upon egg production of S. C. White Leghorns. These different methods of feeding involved in some cases also a difference in the feeds used. The method which has come into rather common use and which is generally recommended is to supply both whole grains and ground feed, giving the former in the litter in two portions daily and the latter in self-feeding hoppers to which the hens have access a part or all of the time. Advice regarding the introduction or removal of one feed or more from the ration has always been that it must be done gradually or a decreased rate of egg production would surely follow. This experiment is the first of a series to be conducted to secure data on these points. The following results are presented, not as giving conclusive results, but only as a report of progress of the experiments. The results will need to be corroborated by future experiments before they may be accepted as conclusive.

PLAN OF EXPERIMENT

Duration.—This experiment was begun December 16, 1915. Results as published in this bulletin cover a period of 728 days ending December 12, 1917. They are given for two periods of 364 days each.

Description of fowls.—S. C. White Leghorns hatched in the spring of 1915 were used in this experiment. With the exception of one or two in each lot, they were hatched between May 15 and 31. Prior to the time this experiment was begun, the pullets in Lots 1 to 6 had produced 29, 31, 37, 34, 71 and 45 eggs, respectively.

Quarters.—Each lot of 30 hens was kept in a pen 10 by 16 feet in size in a house of the shed-roof type 16 by 80 feet in size. Each lot had access to a yard 16 by 80 feet in size. They were confined to the house from the beginning of the experiment to April 24, 1916, and from December 8, 1916, to May 27, 1917, except for a few days during the latter part of March and early April.

Rations.—The following rations were used in this experiment:

Lots 1, 2 and 3.	Grain—Corn, 3; wheat, 2; oats, 1. Mash—Ground corn, 4; bran, 4; middlings, 4. oilmeal, 1; meat scrap, 3.
Lot 4.	Mash—Ground corn, 30; bran, 4; middlings, 4; oilmeal, 1; meat scrap, 3.
Lot 5.	Grain—Corn, 3; wheat, 2; oats, 1. Meat scrap (10 percent as much as grain).

Lot 6. Received an entirely different ration each 4 weeks as follows:

(a) Same as Lot 1 above.
(b) Grain—Shelled corn.
Mash—Ground corn, 8; meat scrap, 5.
(c) Grain—Shelled corn, 3; wheat, 1.
Mash—Ground corn, 2; bran, 1; meat scrap, 2.
(d) Grain—Shelled corn.
Mash—Ground corn, 7; bran, 3; tankage, 4.
(e) Grain—Shelled corn, 3; wheat, 1.
Mash—Ground corn, 4; bran, 2; meat scrap, 2; oilmeal, 1.
(f) Grain—Shelled corn.
Mash—Ground corn, 7; bran, 3; meat scrap, 5.

Ration (e) was left out the first time; after that they were repeated in the order named.

The method of feeding was as follows:

Lot	Grain	Mash
1	In litter	Dry, in hopper
2	In trough	Dry, in hopper
3	In litter	Moist, once daily in trough
4	None	Dry, in hopper
5	In litter	Meat scrap once daily in trough
6	In litter	Dry, in hopper

Sufficient water was added to the mash of Lot 3 to make it moist, and it was fed in a crumbly state.

Mortality.—The number and percentage of hens that died in each lot during each period of the experiment and during the entire experiment are shown in Table 31.

TABLE 31.—MORTALITY

Lot	First period, Dec. 16, 1915—Dec. 13, 1916		Second period, Dec. 14, 1916—Dec. 12, 1917		Entire experiment, Dec. 16, 1915—Dec. 12, 1917	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
1	1	3.3	4	13.8	5	16.7
2	*1	3.3	.....	.....	*1	3.3
3	.....	.....	.....	.....	.....	.....
4	1	3.3	5	17.2	6	20.0
5	3	10.0	5	18.5	8	26.7
6	†2	6.7	‡3	11.1	†‡5	16.7

*In addition one hen was taken out June 19, 1916, because of some trouble which resembled chicken pox or favus.

†One hen was taken out of Lot 6 at the close of the first year because she had produced no eggs.

‡In addition two hens were killed by accident.

Factors other than the ration or method of feeding have considerable influence upon mortality. No hens died in Lot 3, which received wet mash, and only one in Lot 2, which received grain in a trough, thus getting their ration with a minimum amount of exercise. These two methods of feeding would be expected to induce a relatively high rate of mortality. The rate of mortality in the other lots seems to be more nearly normal. Further work must be

done to determine the relative effect these different methods of feeding have upon the rate of mortality during the first 2 or 3 years

Weights.—The average weight and gain or loss in weight per hen during each period and during the entire experiment are shown in Table 32.

TABLE 32.—AVERAGE WEIGHT AND GAIN OR LOSS PER HEN

Lot	Number living at close of period	Average initial weight	Average final weight	Average gain or loss (—) in weight
Dec. 16, 1915—Dec. 13, 1916 (364 days)				
		Pounds	*Pounds*	*Pound*
1	29	3.04	3.15	0.11
2	28	3.00	3.34	.34
3	30	2.98	3.13	.15
4	29	3.02	3.28	.26
5	27	2.93	3.18	.25
6	28	3.03	3.27	.24
Dec. 14, 1916—Dec. 12, 1917 (364 days)				
1	25	3.18	3.12	—.06
2	28	3.34	3.12	—.22
3	30	3.13	2.92	—.21
4	24	3.32	3.05	—.27
5	22	3.18	3.22	.04
6	22	3.34	3.20	—.14
Summary: Dec. 16, 1915—Dec. 12, 1917 (728 days)				
1	25	3.09	3.12	.03
2	28	3.00	3.12	.12
3	30	2.98	2.92	—.06
4	24	3.00	3.05	.05
5	22	2.94	3.22	.28
6	22	3.04	3.20	.16

The heavier gain per hen in Lot 2 during the first period was probably due to a great extent to the fact that they stopped laying about 3 weeks earlier than the other lots.

Feed consumed.—The amount and cost of feed consumed per hen are shown in Table 33.

Except with Lot 2, the feed consumption per hen was slightly higher during the second than during the first year. Lot 1 consumed 4.7 percent more feed than the average of all lots, and Lot 5 6.1 percent less than the average. The cost of feed per hen for Lot 4 is relatively lower than the amount of feed consumed because there was in the ration no wheat or oats, which are valued at a higher price per pound than corn in the prices used in this bulletin

TABLE 33.—AMOUNT AND COST OF FEED CONSUMED PER HEN

Lot	Average number in lot	Materials consumed per hen					Cost of feed per hen*
		Grain	Mash	Grain and mash	Shells	Grit	
		Dec. 16, 1915—Dec. 13, 1916 (364 days)					
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Dollars*
1	29.99	43.56	20.94	64.50	2.67	0.40	1.49
2	29.40	40.87	21.87	62.74	2.60	.32	1.44
3	30.00	42.01	21.00	63.01	2.74	.62	1.45
4	29.90	.....	60.12	60.12	2.72	.80	1.32
5	29.57	52.30	† 5.23	57.53	2.30	.65	1.42
6	29.09	39.22	21.93	61.15	2.29	.32	1.41
		Dec. 14, 1916—Dec. 12, 1917 (364 days)					
1	27.55	43.69	21.93	65.62	2.70	.42	1.51
2	28.00	40.92	21.34	62.26	2.16	.31	1.43
3	30.00	42.85	21.42	64.27	2.60	.81	1.48
4	25.42	.....	63.00	63.00	2.18	.49	1.37
5	24 91	53.85	† 5.38	59.23	1.72	.21	1.45
6	24.48	41.00	20.57	61.57	1.57	.40	1.41
		Summary: Dec. 16, 1915—Dec. 12, 1917 (728 days)					
1	28.77	87.24	42.82	130.06	5.37	.82	3.00
2	28.70	81.79	43.23	125.02	4.77	.63	2.87
3	30.00	84.85	42.42	127.27	5.35	1.42	2.94
4	27.66	.....	122.89	122.89	4.94	1.31	2.68
5	27.24	106.02	†10.60	116.62	4.06	.90	2.86
6	26.78	80.06	42.61	122.67	3.92	.71	2.81

*See page 199 for prices used in calculations.
†Meat scrap.

Eggs produced.—The data given in Table 34 show the average egg production per hen and the average value of eggs per dozen and per hen for each period of the experiment and for the entire experiment.

TABLE 34.—EGGS PRODUCED

Lo	First period, Dec. 16, 1915—Dec. 13, 1916			Second period, Dec. 14, 1916—Dec. 12, 1917			Entire experiment, Dec. 16, 1915—Dec. 12, 1917		
	Average eggs per hen	Average value of eggs		Average eggs per hen	Average value of eggs		Average eggs per hen	Average value of eggs	
		Per dozen	Per hen		Per dozen	Per hen		Per dozen	Per hen
		Cents	*Dollars*		*Cents*	*Dollars*		*Cents*	*Dollars*
1	135.0	30.4	3.42	114.7	29.2	2.79	250.6	29.9	6.24
2	133.6	29.9	3.33	115.6	29.1	2.81	249.6	29.5	6.15
3	133.9	30.1	3.36	122.3	29.4	3.00	256.2	29.8	6.35
4	126.3	29.9	3.15	120.0	29.5	2.95	246.8	29.7	6.11
5	116.2	29.8	2.88	112.4	29.1	2.73	228.9	29.5	5.63
6	*129.9	30.2	3.27	124.8	29.4	3.06	*255.2	29.8	6.35

*By eliminating the hen in Lot 6 that produced no eggs during the first year the average egg production for this lot during the first year is 134.6, and during the entire experiment 266.

Except for Lot 5 the egg production of the various lots in this experiment was remarkably uniform. If the hen is eliminated in Lot 6, as indicated in the footnote under Table 34, the best average

production per hen was secured in Lot 6, given a change of ration every 4 weeks. The total production of eggs per lot during the entire experiment was 7,211, 7,164, 7,685, 6,826, 6,236 and 6,835 for Lots 1 to 6, respectively. Lot 3 had the highest total production, partly because the 30 hens lived throughout the entire experiment. This was rather unusual, and poultrymen should not adopt the feeding of wet mash, expecting thereby to eliminate mortality from the flock, because disappointment would likely follow such a procedure. On account of the extra labor involved in feeding, as well as the relatively poor results in egg production from the ration fed to Lot 5, the methods of feeding employed for Lots 3 and 5 do not commend themselves to the poultryman, but the results of this one experiment indicate that a choice of one of the other four methods can well be made on the basis of convenience. The results secured with Lot 6 would indicate that a careful study of market prices should be made and the ration changed, abruptly if desirable, when market prices of feeds justify, provided the ratio between nitrogenous and carbonaceous feeds is maintained in approximately the same relation as in the rations used for Lot 6 in this experiment.

Figures showing the amount and cost of feed consumed per dozen eggs are given in Table 35.

TABLE 35.—AMOUNT AND COST OF FEED CONSUMED PER DOZEN EGGS

Lot	First period, Dec. 16, 1915—Dec. 13, 1916				Second period, Dec. 14, 1916—Dec. 12, 1917				Entire experiment, Dec. 16, 1915—Dec. 12, 1917			
	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*
1	3.87	1.86	5.73	13.2	4.57	2.29	6.86	15.8	4.18	2.05	6.23	14.3
2	3.67	1.96	5.63	13.0	4.25	2.22	6.47	14.8	3.93	2.08	6.01	13.8
3	3.77	1.88	5.65	13.0	4.20	2.10	6.30	14.5	3.97	1.99	5.96	13.8
4	.....	5.71	5.71	12.5	.....	6.30	6.30	13.7	.....	5.97	5.97	13.0
5	5.40	*.54	5.94	14.6	5.75	*.57	6.32	15.5	5.56	*.56	6.12	15.0
6	3.62	2.02	5.64	13.0	3.94	1.98	5.92	13.5	3.77	2.00	5.77	13.2

*Meat scrap.

The variation in feed required per dozen eggs by the various lots was 0.31 pound the first year. It increased to 0.94 pound the second year. For the 2 years the feed requirement per dozen eggs varied from 5.77 pounds for Lot 6 to 6.23 pounds for Lot 1. The cost of feed per dozen eggs was lowest for Lot 4 (13 cents) followed closely by Lot 6 (13.2 cents). The highest cost per dozen was 15 cents for Lot 5.

Summary.—A summary of this experiment for the 2-year period, December 16, 1915, to December 12, 1917 (728 days), is given in Table 36.

TABLE 36.—SUMMARY

Lot	Average number in lot	Mortality	Gain or loss (—) in weight per hen	Grain and mash consumed per hen	Eggs produced per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen*
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollars*
1	28.77	16.7	0.03	130.06	250.6	6.23	3.24
2	28.70	3.3	.12	125.02	249.6	6.01	3.28
3	30.00	.....	—.06	127.27	256.2	5.96	3.41
4	27.66	20.0	.05	122.89	246.8	5.97	3.43
5	27.24	26.7	.28	116.62	228.9	6.12	2.77
6	26.78	16.7	.16	122.67	†255.2	5.77	3.54

*See page 199 for prices used in calculations.
†See footnote Table 34.

On the basis of the results of this one experiment, if Lot 5 is eliminated from consideration, there is little to commend one method of feeding over another. The extra labor involved in feeding a wet mash every day at noon is one point against this method of feeding. So far as feed required per dozen eggs is concerned, as well as difference between cost of feed and value of eggs, Lot 6, given a change of ration every 4 weeks, seems to have a slight advantage. Results secured with this lot appear to disprove the statement frequently made that any change in the ration of laying hens unless made very gradually will produce unsatisfactory results.

When a wet mash is fed, it should have only sufficient water added to make it crumbly rather than sloppy.

The method of feeding employed with Lot 4 has much to commend it to persons who cannot conveniently give regular attention to the flock at feeding time. Care must be taken, however, to use a hopper which will not clog easily; otherwise the hens might be without feed for a time. Any hopper should be given frequent attention if there is to be assurance that feed is constantly available.

EFFECT OF EARLY, MEDIUM AND LATE HATCHING UPON EGG PRODUCTION OF S. C. WHITE LEGHORNS

EXPERIMENT V

OBJECT OF EXPERIMENT

The object of this experiment is to study the effect of different dates of hatching upon the number, value and feed cost of eggs produced by S. C. White Leghorns.

PLAN OF EXPERIMENT

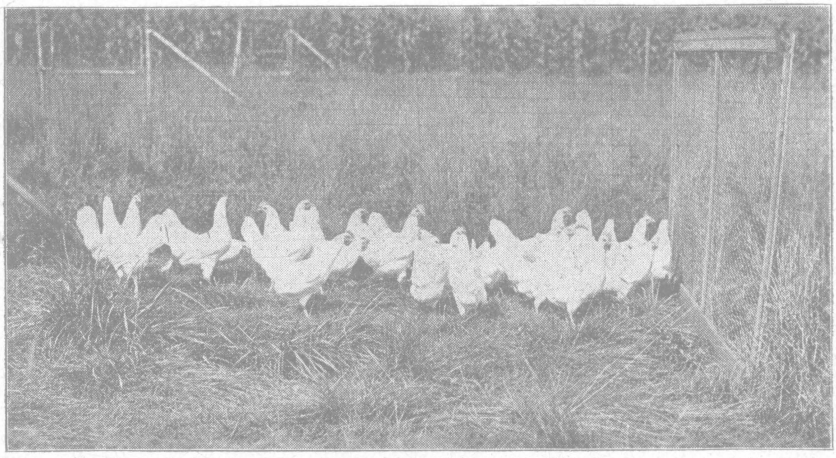
Duration.—The data for each lot cover the period from the beginning of egg production to the time when it ceased after the

first year's production. The time covered for each lot was as follows:

Lot 1 (hatched February 22)..Aug. 10, 1916—Oct. 31, 1917 (448 days)
Lot 2 (hatched April 20).....Nov. 2, 1916—Nov. 28, 1917 (392 days)
Lot 3 (hatched June 13).....Dec. 28, 1916—Nov. 28, 1917 (336 days)

Description of fowls:—S. C. White Leghorn pullets hatched on the dates indicated above were used in this experiment. Thirty of the more mature pullets out of a lot of about twice this number were selected to make each of the lots. The appearance on August 17, 1916, of Lot 1, as well as that of the chicks from which Lots 2 and 3 were selected, is shown in the accompanying illustrations.

Quarters.—Each lot was housed in one of the buildings shown on the frontispiece of this bulletin. These buildings are 10 by 12



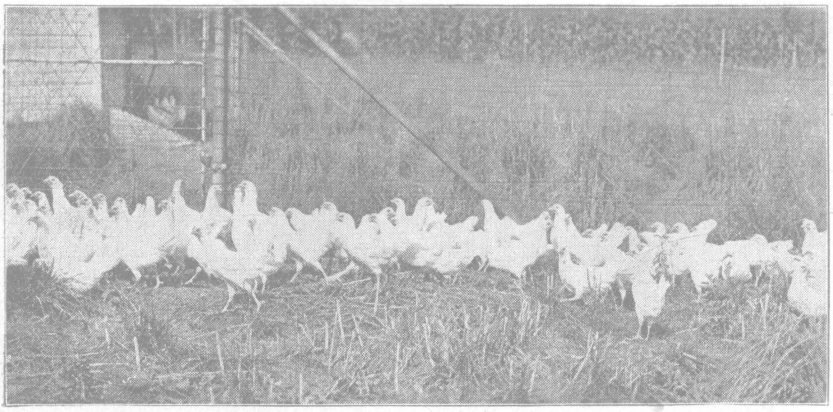
Lot 1 of Experiment V as they appeared August 17, 1916

feet in size. Two yards, each 33 by 220 feet in size (one-sixth of an acre), were available for each lot. The fowls were changed from one lot to the other several times a year. The yards were well covered with bluegrass and white clover and provided much more grass than the pullets could utilize.

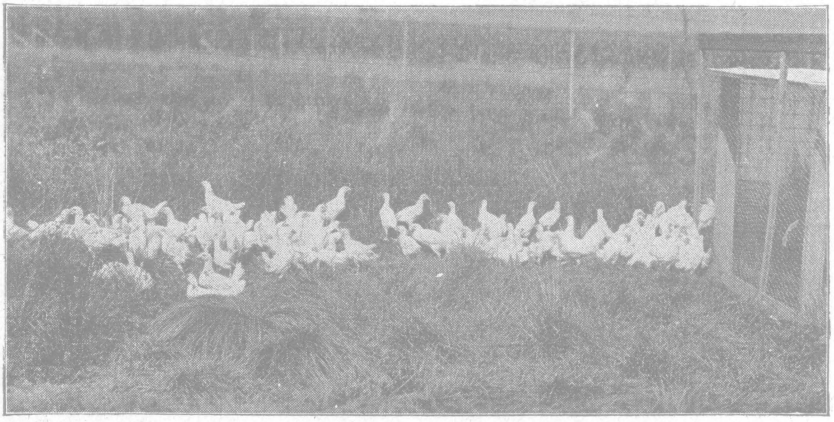
Ration.—The ration for Lot 2 in Experiment III*a* (see p. 212) was used in this experiment.

RESULTS OF EXPERIMENT

Mortality.—The mortality in Lots 1, 2 and 3, was two, three and one, respectively, or 6.7, 10 and 3.3 percent. There were 30 pullets in each lot when the experiment was begun.



Lot 2 of Experiment V was selected from these pullets
(Photographed August 17, 1916)



Lot 3 of Experiment V was selected from these pullets
(Photographed August 17, 1916)

Weights.—The average weight at the beginning and close and the average gain per pullet are shown in Table 37. Initial and final weights for each lot were taken on the dates mentioned on the preceding page.

TABLE 37.—AVERAGE WEIGHT AND GAIN OR LOSS PER PULLET

Lot	Number living at close of period	Average initial weight	Average final weight	Average gain or loss (—)
		Pounds	*Pounds*	*Pound*
1	28	2.87	2.91	0.04
2	27	2.93	3.08	.15
3	29	2.80	2.72	—.08

Lot 2, hatched April 20, weighed slightly more than the other lots at the beginning and at the close of the experiment. All lots were considerably heavier during the year than the figures above would indicate. The heaviest average weights per pullet were 3.65, 3.63 and 3.21 for Lots 1, 2 and 3 in the order named. The heaviest weight for Lot 3 was secured January 24, and for Lots 1 and 2 on February 21.

Feed consumed.—The amount and cost of feed consumed per pullet are given in Table 38.

TABLE 38.—AMOUNT AND COST OF FEED CONSUMED PER PULLET

Lot	Average number in lot	Materials consumed per pullet					Cost of feed per pullet*
		Grain	Mash	Grain and mash	Shells	Grit	
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Dollars*
1	29.01	53.96	29.59	83.55	3.00	1.05	2.03
2	28.36	48.36	27.33	75.69	3.42	.93	1.85
3	29.50	40.28	20.33	60.61	1.97	.91	1.47

*See page 199 for prices used in calculations.

When the length of time covered by the figures for each lot in Table 38 is considered, the feed consumption per pullet is not far different. The average daily consumption per pullet was 0.186, 0.193 and 0.180 pound for Lots 1, 2 and 3, respectively.

Eggs produced.—The average egg production and average value of eggs per dozen and per pullet are given in Table 39.

TABLE 39.—EGGS PRODUCED

Lot	Average eggs per pullet	Average value of eggs	
		Per dozen	Per pullet
		Cents	*Dollars*
1	166.9	30.5	4.25
2	156.4	30.8	4.01
3	144.0	29.8	3.58

The egg production per pullet with all lots was relatively high. Selecting the most mature pullets out of twice the number doubtless was largely responsible for this high egg production. The production of Lot 3 was especially good when it is considered that the eggs were produced during 48 weeks.

Table 40 shows the feed consumed per dozen eggs produced and the cost of feed.

TABLE 40.—FEED CONSUMED PER DOZEN EGGS

Lot	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*
1	3.88	2.13	6.01	14.6
2	3.71	2.10	5.81	14.2
3	3.36	1.69	5.05	12.2

Lot 3, late hatched, proved to be the most economical in feed required per dozen eggs. Lot 1 required 19 percent, and Lot 2, 15 percent more feed per dozen eggs than Lot 3.

Figures showing the distribution of egg production during various periods for each lot are shown in Table 41.

TABLE 41.—PERCENTAGE EGG PRODUCTION

Date	Lot 1	Lot 2	Lot 3
Aug. 10—Sept. 6	36.31		
Sept. 7—Oct. 4	47.38		
Oct. 5—Nov. 1	25.60		
Nov. 2—29	6.43	17.62	
Nov. 30—Dec. 27	6.67	39.52	
Dec. 28—Jan. 24	6.32	29.68	19.76
Jan. 25—Feb. 21	14.16	29.06	40.12
Feb. 22—Mar. 21	49.14	51.48	56.90
Mar. 22—Apr. 18	69.46	68 60	73.69
Apr. 19—May 16	68.35	65.15	66.79
May 17—June 13	61.95	58.74	69.96
June 14—July 11	62.12	53.55	52.59
July 12—Aug. 8	58.80	44.58	46.80
Aug. 9—Sept. 5	53.70	43.92	35.59
Sept. 6—Oct. 3	30.23	31.75	36.21
Oct. 4—31	4.08	17.06	10.47
Nov. 1—28		6.08	3.20

The egg production for Lot 1 for 18 weeks from October 19 to February 22 was very light, amounting to only 8.77 percent. Nearly all the pullets in Lot 1 went through a complete molt during that time. In fact, their performance so far as molt and egg production are concerned, after they had been laying for 10 weeks, was not unlike that of hens hatched in April or early May after they have produced eggs for a year. For 12 weeks from June 14 to September 5, 1917, however, the production of this lot was somewhat higher than that of either of the other lots. For the 20 weeks from January 25 to June 13, Lot 3 produced a higher percentage of eggs than either Lot 1 or 2. Lot 2 had the advantage in production for 12 weeks from November 2 to January 24.

Summary.—Figures showing a summary of this experiment are given in Table 42.

TABLE 42.—SUMMARY

Lot	Average number in lot	Mortality	Gain or loss (—) in weight per pullet	Grain and mash consumed per pullet	Eggs produced per pullet	Feed consumed per dozen eggs	Value of eggs less cost of feed per pullet*
		Per cent	*Pound*	*Pounds*		*Pounds*	*Dollars*
1	29.01	6.7	0.04	83.55	166.9	6.01	2.22
2	28.36	10 0	.15	75.69	156.4	5.81	2.16
3	29.50	3.3	—.08	60.61	144.0	5.05	2.11

*See page 199 for prices used in calculations

On the basis of the first year's results, there would seem to be little difference, with prices as used in this publication, in favor of any one lot so far as returns over cost of feed are concerned. Because of the much shorter time involved with Lot 3, this lot would seem to have the advantage. However, the performance of these hens during their second year of laying may influence to a considerable extent the relative profit secured from the different lots. Moreover, these results will not apply to slower-maturing breeds.

COMPARISON OF CORN AND WHEAT

OBJECT OF EXPERIMENT

Wheat has been considered a feed of great value for poultry in sections where it is available. Few writers and speakers had the temerity prior to last year to recommend rations in which wheat was not used as an important ingredient. Corn was considered by most agricultural teachers, especially outside the cornbelt, to be "too heating" or "too fattening" for any large use in the ration for laying hens, particularly in summertime. There are still many feeders who follow the practice of increasing the proportion of

wheat in the ration during the hot summer months and increasing the proportion of corn during the winter. Wheat, under usual market conditions, is more costly per pound than corn.

A series of experiments was begun in 1915 to determine to what extent wheat can be replaced by corn in rations for laying hens. Results of the first two experiments of this series are presented below. These experiments were conducted at the Southeastern Test Farm, in Meigs County.

EXPERIMENT VI*a*

PLAN OF EXPERIMENT

Duration.—This experiment was begun October 31, 1915, and closed October 28, 1916, covering a period of 364 days.

Description of fowls.—There were 50 S. C. White Leghorn pullets in each lot. These pullets were hatched from April 13 to May 15, 1915, and reared at Wooster. They were shipped to Carpenter on October 22.

Quarters.—Each of these lots occupied quarters similar to those occupied by the confined lot in Experiment I*c*. (See p. 204.)

Rations.—The following rations were used in this experiment:

Lot 1. Grain—Shelled corn.
Mash—Ground corn, 4; bran, 2; meat scrap, 2; oilmeal, 1.
Lot 2. Grain—Wheat.
Mash—Ground wheat, 4; bran, 2; meat scrap, 2; oilmeal, 1.

The rations when the fowls consumed twice as much mash as grain contained 81.5 percent of corn or wheat, 7.4 percent of bran, 7.4 percent of meat scrap, and 3.7 percent of oilmeal.

RESULTS OF EXPERIMENT

Mortality.—During the year, four pullets, or 8 percent, died in Lot 1, and 26 pullets, or 52 percent, in Lot 2. The mortality by months in Lot 2 was as follows: February, 2; April, 2; May, 5; June, 6; July, 6; August, 1; September, 3; and October, 1. In Lot 1, one pullet died in each of the months of November, March, June and September. This heavy mortality during the summer months in the wheat lot is an indication that the practice of some poultrymen to increase the amount of wheat in the ration during hot weather is not to be recommended.

Weights.—The average initial weight of the 46 hens that lived until the close of the experiment in Lot 1 was 2.83 pounds and the average final weight 3.29 pounds, making an average gain per pullet of 0.46 pound. The average initial weight of the 24 hens in Lot 2

that were living at the close of the experiment was 2.74 pounds, average final weight 2.93 pounds, and the average gain in weight 0.19 pound.

Feed consumed.—The average amount and cost of feed consumed per pullet are shown in Table 43.

TABLE 43.—AMOUNT AND COST OF FEED CONSUMED PER PULLET

Lot	Average number in lot	Materials consumed per pullet					Cost of feed per pullet*
		Grain	Mash	Grain and mash	Shells	Grit	
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Pound*	*Dollars*
1	47.89	37.95	19.46	57.41	1.29	0.08	1.23
2	40.83	39.32	18.56	57.88	1.45	.10	1.72

*See page 199 for prices used in calculations.

The average amount of feed consumed per pullet was almost the same for each lot. The cost of feed on the basis of prices used in this bulletin was 49 cents per pullet, or 39.8 percent, higher for Lot 2 than for Lot 1.

Eggs produced.—The average production of Lot 1 was 89.5 eggs, their average value per dozen 30 cents, and their average total value $2.23. The average production per pullet in Lot 2 was 95.7 eggs, their average value per dozen 30.2 cents, and the average value of eggs per pullet $2.41. The average production in both lots was low, due largely no doubt to the fact that they were closely confined. The production of these pullets compares favorably with that of the confined pullets in Experiment Ic (Bul. 291) which was 89.7 eggs each. The average production per pullet was 6.2 eggs higher in Lot 2 than in Lot 1. However, these figures are not comparable because of the high mortality in Lot 2. It seems reasonable to believe that the pullets which lived throughout the experiment in Lot 2 were those of stronger vitality that would have been expected to produce more eggs than some of the weaker ones. Furthermore, there were fewer pullets in Lot 2 during the period of low production the latter part of the experiment which would also give a higher average production per pullet for the flock.

The amount and cost of feed consumed per dozen eggs are given in Table 44.

TABLE 44.—AMOUNT AND COST OF FEED CONSUMED PER DOZEN EGGS

Lot	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*
1	5.09	2.61	7.70	16.5
2	4.93	2.33	7.26	21.5

Lot 1 required 6.2 percent more feed per dozen eggs than Lot 2. The cost of feed per dozen eggs, on the basis of prices used, was 30.3 percent higher for Lot 2 than for Lot 1.

Summary.—A summary of the results of this experiment is given in Table 45.

TABLE 45.—SUMMARY

Lot	Average number in lot	Mortality	Gain in weight per pullet	Grain and mash consumed per pullet	Eggs produced per pullet	Feed consumed per dozen eggs	Value of eggs less cost of feed per pullet*
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollar*
1.	47.89	8	0.46	57.41	89.5	7.70	1.00
2	40.83	52	.19	57.88	95.7	7.26	.69

*See page 199 for prices used in calculations

The results of this experiment are decidedly in favor of the ration containing 81.5 percent of corn as compared with the one containing the same percentage of wheat, when the pullets are closely confined.

EXPERIMENT VI*b*

Duration.—This experiment was begun November 26, 1916. The following data cover a period of 364 days, ending November 24, 1917. The ration for Lot 4 was changed May 13, 1917, and the results are presented in two periods to conform to this change in ration, the first covering 168 days from November 26, 1916, to May 12, 1917, and the second, 196 days from May 13 to November 24, 1917.

Description of fowls.—There were 50 S. C. White Leghorn pullets in each lot when the experiment was begun. They were hatched April 20 and May 3, 1916, and reared at Wooster. They were shipped to Carpenter November 17, 1916.

Quarters.—Each lot occupied quarters similar to those occupied by the confined lot in Experiment I*c* as described on page 204.

Rations.—Rations as described below were used in this experiment:

Lot 1. Grain—Shelled corn.
Mash—Ground corn, 4; bran, 2; meat scrap, 2; oilmeal, 1.

Lot 2. Grain—Shelled corn, 2; wheat, 1.
Mash—(Ground corn, 2; ground wheat, 1), 4; bran, 2; meat scrap, 2; oilmeal, 1.

Lot 3. Grain—Shelled corn, 1; wheat, 2.
Mash—(Ground corn, 1; ground wheat, 2), 4; bran, 2; meat scrap, 2; oilmeal, 1.

Lot 4. Grain—Wheat.
Mash—Ground wheat, 4; bran, 2; meat scrap, 2; oilmeal, 1.
Beginning May 13, Lot 4 was fed the same ration as Lot 1.

The percentage of each feed in the ration when half as much mash as grain is consumed is as follows:

Lot	Corn	Wheat	Bran	Meat scrap	Oilmeal
1	81.5	....	7.4	7.4	3.7
2	54.3	27.2	7.4	7.4	3.7
3	27.2	54.3	7.4	7.4	3.7
4*	.....	81.5	7.4	7.4	3.7

*Until May 13. From this date same as Lot 1.

Mortality.—The number and percentage of hens that died in each lot are given in Table 46.

TABLE 46.—MORTALITY

Lot	First period, Nov. 26, 1916—May 12, 1917		Second period, May 13—Nov. 24, 1917 (Lot 4 fed same as Lot 1)		Entire experiment, Nov. 26, 1916—Nov. 24, 1917	
	Number	*Percent*	*Number*	*Percent*	*Number*	*Percent*
1	.....	.....	2	4.0	2	4
2	1	2	2	4.1	3	6
3	1	2	6	14.3	7	14
4	21	42	1	3.4	.....	.....

As in the preceding experiment in this series, the mortality was exceptionally heavy with Lot 4, which received a ration containing 81.5 percent of wheat. In this experiment, however, the heavy mortality began earlier in the year. Two pullets died in February, 11 in March, 4 in April and 4 from May 1 to 12. The ration of this lot was changed on May 13 to that given Lot 1, to note what effect this would have upon mortality. One pullet died on May 19, and none thereafter during the period of experiment.

No significant effect upon mortality was noticed when the ration contained 27.2 percent of wheat, as the mortality in Lot 2 was only slightly heavier than in Lot 1, which received no wheat. Lot 3, fed a ration containing 54.3 percent of wheat, showed a decided increase in the rate of mortality over Lots 1 and 2. It is possible, of course, that this increased mortality was not due to the ration. Further work must be done to determine the amount of wheat that can be used in the ration before the rate of mortality is seriously affected.

Weights.—The average weight and gain or loss per pullet for each period and for the entire experiment for Lots 1, 2 and 3 are shown in Table 47.

TABLE 47.—AVERAGE WEIGHT AND GAIN OR LOSS PER PULLET

Lot	Number living at close of period	Average initial weight	Average final weight	Average gain or loss (—) in weight
	Nov. 26, 1916—May 12, 1917 (168 days)			
		Pounds	*Pounds*	*Pound*
1	50	2.85	2.93	0.08
2	49	2.83	2.95	.12
3	49	2.77	2.97	.20
4	29	2.76	2.92	.16
	May 13—Nov. 24, 1917 (196 days) (Lot 4 given same ration as Lot 1)			
1	48	2.92	3.26	.34
2	47	2.95	3.17	.22
3	43	2.96	2.94	—.02
4	28	2.91	3.41	.50
	Nov. 26, 1916—Nov. 24, 1917 (364 days)			
1	48	2.86	3.26	.40
2	47	2.83	3.17	.34
3	43	2.77	2.94	.17

Except during the first period the lots receiving no wheat in the ration made larger gains in weight than the other lots. The lot receiving 27.2 percent of wheat gained twice as much as the lot receiving 54.3 percent of wheat.

Feed consumed.—The amount and cost of feed consumed per pullet are given in Table 48.

TABLE 48.—AMOUNT AND COST OF FEED CONSUMED PER PULLET

Lot	Average number in lot	Materials consumed				Cost of feed per pullet*
		Grain	Mash	Grain and mash	Shells	
	Nov. 26, 1916—May 12, 1917 (168 days)					
		Pounds	*Pounds*	*Pounds*	*Pounds*	*Dollars*
1	50.00	17.94	8.71	26.65	0.47	0.57
2	49.80	18.87	9.04	27.91	.47	.67
3	49.96	18.69	8.98	27.67	.87	.75
4	44.33	17.98	7.61	25.59	.43	.76
	May 13—Nov. 24, 1917 (196 days)					
1	49.54	18.40	9.13	27.53	.25	.59
2	48.46	18.61	8.91	27.52	.18	.66
3	47.02	17.57	7.88	25.45	.37	.68
4	28.03	17.61	8.48	26.09	.11	.55
	Nov. 26, 1916—Nov. 24, 1917 (364 days)					
1	49.75	36.35	17.84	54.19	.72	1.16
2	49.08	37.52	17.98	55 50	.65	1.33
3	48.38	36.38	16.93	53.31	1.26	1.43

*See page 199 for prices used in calculations.

The amount of feed consumed per pullet by the various lots varied slightly. During the year Lot 3 consumed slightly less and Lot 2 slightly more feed than Lot 1. The cost of feed per pullet increased as the proportion of wheat was increased in the rations, since corn was valued at $2 and wheat at $3 per hundredweight. No appreciable amount of grit was consumed doubtless due to the fact that the yards to which the pullets had access contained gravel in abundance.

Eggs produced.—The number and value of eggs produced per pullet are shown in Table 49.

TABLE 49.—EGGS PRODUCED

Lot	First period, Nov. 26, 1916–May 12, 1917			Second period, May 13—Nov. 24, 1917 (Lot 4 given same ration as Lot 1)			Entire experiment, Nov. 26, 1916—Nov. 24, 1917		
	Average eggs per pullet	Average value of eggs		Average eggs per pullet	Average value of eggs		Average eggs per pullet	Average value of eggs	
		Per dozen	Per pullet		Per dozen	Per pullet		Per dozen	Per pullet
		Cents	*Dollars*		*Cents*	*Dollars*		*Cents*	*Dollars*
1	56.9	31.3	1.48	41.4	30.1	1.04	98.4	30.8	2.53
2	57.1	31.1	1.48	32.5	29.3	.79	90.0	30.5	2 29
3	57.7	31.5	1.52	28.6	29.6	.71	87.5	30.9	2.25
4	35.9	33 0	.99	32.0	30.0	.80	.....	.... .	. ...

During the first period there was less than one egg difference in the average egg production per pullet in Lots 1, 2 and 3. Lot 4, which received a ration containing 81.5 percent of wheat, produced 21 eggs per pullet, or 36.9 percent, less than Lot 1, fed 81.5 percent of corn in the ration. During the second period Lot 1 produced 27.4 percent more eggs than Lot 2 and 44.8 percent more than Lot 3. Lot 4, which received the same ration as Lot 1, did not produce as well as Lot 1, but made a much better showing than in the first part of the experiment. During the year Lot 1 with no wheat in the ration produced 9.3 percent more eggs per pullet than Lot 2 fed 27.2 percent of wheat, and 12.5 percent more than Lot 3 which received 54.3 percent of wheat.

The amount and cost of feed consumed per dozen eggs are given in Table 50.

TABLE 50.—AMOUNT AND COST OF FEED CONSUMED PER DOZEN EGGS

Lot	First period, Nov. 26, 1916—May 12, 1917				Second period, May 13—Nov. 24, 1917				Entire experiment, Nov. 26, 1916—Nov. 24, 1917			
	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost	Grain	Mash	Total	Cost
	Pounds	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*	*Pounds*	*Pounds*	*Pounds*	*Cents*
1	3.78	1.84	5.62	12.0	5.33	2.64	7.97	17.4	4.43	2.17	6.60	14.1
2	3.97	1.90	5.87	14.1	6.87	3.29	10.16	24.4	5 00	2.40	7.40	17.8
3	3.88	1.87	5.75	15.5	7.37	3.30	10.67	28.6	4.99	2 32	7.31	19.7
4	6.01	2.55	8.56	25.3	6.59	3.18	9.77	20.8	.....	.....	.....	.....

The amount and cost of feed consumed per dozen eggs was lower with Lot 1 than with Lots 2 and 3. Lot 4 required much more feed per dozen eggs and the cost was much higher than for Lots 2 and 3 during the first part of the experiment, but required less feed per dozen eggs than Lots 2 and 3 during the second part of the experiment when fed a ration containing no wheat.

Summary.—A summary of the results of this experiment is given in Table 51.

TABLE 51.—SUMMARY

Lot	Average number in lot	Mortality	Gain or loss (—) in weight per pullet	Grain and mash consumed per pullet	Eggs produced per pullet	Feed consumed per dozen eggs	Value of eggs less cost of feed per pullet*
			Nov. 26, 1916—May 12, 1917 (168 days)				
		Percent	*Pound*	*Pounds*		*Pounds*	*Dollars*
1.....	50.00	.....	0.04	26.65	56.9	5.62	0.91
2.....	49.80	2.0	.12	27.91	57.1	5.87	.81
3.....	49.96	2.0	.20	27.67	57.7	5.75	.77
4.....	44 33	42.0	.16	25.59	35.9	8.56	.23
			May 13—Nov. 24, 1917 (196 days) (Lot 4 given same ration as Lot 1)				
1.....	49.54	4.0	.34	27.53	41.4	7.97	.45
2.....	48.46	4.1	.22	27.52	32.5	10.16	.13
3.....	47.02	14.3	—.02	25.45	28.6	10.67	.03
4...	28.03	3.4	.50	26.09	32.0	9.77	.25
			Nov. 26, 1916—Nov. 24, 1917 (364 days)				
1.....	49.75	4.0	.40	54.19	98.4	6.60	1.37
2.....	49.08	6.0	.34	55.50	90.0	7.40	.96
3.....	48.38	14.0	.17	53.31	87.5	7.31	.82

*See page 199 for prices used in calculations.

The results of this experiment indicate that corn has a decided advantage over wheat for use as the principal part of the ration for laying hens. This advantage was even more decided during the second period in this experiment which included the hot summer weather, a time when many feeders have considered it desirable to increase the proportion of wheat in the ration. The ration contain-

ing no wheat gave best results in this experiment. The addition of wheat decreased the production, increased the feed consumption per unit of production, and made a decided increase in the cost of feed per unit of production. There is some evidence that the use of a ration containing 54.3 percent of wheat increased the rate of mortality.

On the basis of the results of this experiment, the use of wheat in the ration for laying hens is not advisable unless it costs less per pound than corn, and then it should not exceed 25 to 30 percent of the total ration. These results are of especial importance at this time when wheat is so badly needed for human food. It is perhaps a little easier for us to be patriotic to the extent of saving all wheat for human consumption rather than feeding it to laying hens, when we know that we are at the same time increasing the profit from egg production.

SUMMARY

RANGE VS. CONFINEMENT

Experiment I*b*. (Continued from Bul. 291.)—Data reported in this bulletin were secured from November 28, 1915 to November 24, 1917, a period of 728 days. S. C. White Leghorns hatched in 1913 and 1914 were used.

Mortality was 18.2 and 18.4 percent in the confined lot and 22 and 26 percent in the range lot for the 2 years.

The average grain and mash consumption per hen was 1.6 percent higher for the range lot than for the confined lot.

During the first year (this being the third year of production for these hens) the hens on range produced 15.5 percent more eggs per hen and during the second year 11.2 percent more than those in confinement.

The confined hens consumed 12 percent more feed per dozen eggs produced than those on range.

Experiment I*c*. (Continued from Bul. 291.)—Data presented herein were secured during 336 days beginning November 28, 1915. This was the second year of production for these hens.

The mortality was 17.7 percent for the confined lot and 34.2 percent for the range lot.

The average feed consumption per hen for the confined lot was 3.5 percent more than for the lot on range.

The average egg production per hen was 53.6 percent higher for the range lot than for the confined lot.

The confined lot consumed 58.7 percent more feed per dozen eggs than the lot on range.

VARIETY VS. SIMPLE RATIONS

COMPARISON OF TANKAGE AND MEAT SCRAP

Experiment II*c*.—This experiment was begun November 11, 1915, and lasted 728 days. S. C. White Leghorns hatched in the spring of 1915 were used.

Table 52 shows a summary, on a percentage basis, of the results of this experiment. Lot 1, fed a ration made up of corn and meat scrap, is used as a standard for comparison.

TABLE 52.—SUMMARY OF RESULTS ON PERCENTAGE BASIS

Lot	Feeds used in ration	Percentage mortality	Feed consumed per hen	Eggs produced per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen*
1	Corn, meat scrap.	100	100.0	100.0	100.0	100.0
2	Corn, bran, meat scrap	233	99.6	100.5	99.2	102.8
3	Corn, wheat, oats, bran, middlings, oil-meal, meat scrap.....	233	110.3	108.3	102.0	107.4
4	Corn, bran, tankage.....	133	98.9	99.8	99.2	105.3

*See page 199 for prices used in calculations.

There is so little difference between the best and poorest of these rations, so far as results are concerned, that the poultryman may well be guided in his selection of a ration by convenience in using and cost of the ration.

By comparing results secured with Lots 2 and 4, it will be observed that meat scrap and tankage as used in these rations were of practically equal value. This gives the tankage a somewhat higher value per pound than that of meat scrap because a smaller proportion of the tankage was used.

VARIOUS AMOUNTS OF PROTEIN IN RATIONS

FOR BARRED PLYMOUTH ROCKS

Experiment III*a*. (Continued from Bul. 291.)—The data reported herein were secured during 224 days beginning December 12, 1915. The hens used were hatched in the spring of 1914.

The mortality was 28.6, 27.9 and 10.3 percent for Lots 1, 2 and 3, receiving rations carrying approximately 10, 15 and 20 percent of crude protein, respectively.

Lot 1 consumed 7.6 percent more feed per hen and Lot 2, 10.4 percent more than Lot 3.

Lot 2 produced 3.6 percent more eggs per hen than Lot 1 and 31.1 percent more than Lot 3.

Feed consumed per dozen eggs was 9.35, 9.27 and 11 pounds for Lots 1, 2 and 3, respectively.

Value of eggs less cost of feed per hen was 45 cents and 35 cents for Lots 1 and 2. With Lot 3 the cost of feed was the same as the value of eggs produced.

FOR S. C. WHITE LEGHORNS

Experiment III*a*.—The data for these fowls were secured during 308 days beginning December 12, 1915.

The mortality was 16.4, 9.6 and 5.4 percent for Lots 1, 2 and 3, respectively.

Egg production per hen was 12.1 percent higher for Lot 2 than for Lot 1 and 21.4 percent higher than for Lot 3.

Feed consumed per dozen eggs was 6.72, 6.41 and 7.27 pounds for Lots 1, 2 and 3, respectively.

Value of eggs less cost of feed per hen was 95 cents, $1.03 and 63 cents for Lots 1, 2 and 3, respectively.

The Barred Rocks required 44.3 percent more feed per dozen eggs than the Leghorns on the basis of the figures as presented. These figures favor the Barred Rocks, because they do not cover the relatively light production for the hens of this breed during late summer and early fall. The Rocks required 52.4 percent more feed per dozen eggs than the Leghorns during the same period.

Experiment III*b*.—This experiment was begun November 26, 1916, and lasted 364 days. S. C. White Leghorn pullets were used.

The percentage mortality was 6.7, 15 and 16.7 percent for Lots 1, 2 and 3, respectively.

Lot 2 consumed 1.3 percent more feed per pullet than Lot 3 and 10.7 percent more than Lot 1.

The egg production per pullet was 49.1 percent higher for Lot 2 than for Lot 1 and 8.6 percent higher than for Lot 3.

Lot 3 required 7.2 percent more feed per dozen eggs and Lot 1, 34.7 percent more than Lot 2.

The value of eggs less cost of feed was $1.09, $2.01 and $1.58 for Lots 1, 2 and 3, respectively.

The results of this experiment, excepting the mortality in Lot 3, were almost the same as those secured during the first year in Experiment III*a*, reported in Bulletin 291.

DIFFERENT METHODS OF FEEDING

S. C. White Leghorns hatched in the spring of 1915 were used in this experiment which was begun December 16, 1915, and lasted 728 days.

A summary of the results of this experiment on a percentage basis, with Lot 1 as a standard for comparison, is given in Table 53.

TABLE 53.—SUMMARY OF RESULTS ON PERCENTAGE BASIS

Lot	Method of feeding		Percentage of mortality	Feed consumed per hen	Eggs produced per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen*
	Grain	Mash					
1	Litter	Dry, hopper	100.0	100.0	100 0	100 0	100 0
2	Trough	Dry, hopper	19 8	96.1	99 6	96 5	101 2
3	Litter	Moist, trough		97.8	102 2	95 7	105 2
4	None	Dry, hopper	119 8	94.5	98 5	95 8	105 9
5	Litter	Meat scrap, trough	159 8	89.7	91 3	98 2	85 5
6	†Litter	Hopper	100.0	94 3	101 8	92 6	109 3

*See page 199 for prices used in calculations
†Different ration every 4 weeks

Results secured in this experiment will need to be corroborated by other experiments before they may be accepted as conclusive.

EFFECT OF EARLY, MEDIUM AND LATE HATCHING UPON EGG PRODUCTION OF S. C. WHITE LEGHORNS

The mortality was 6.7, 10 and 3.3 percent for Lots 1, 2 and 3, hatched February 22, April 20 and June 13, respectively.

The average feed consumption per pullet daily for the time covered by the data presented in this bulletin (see page 223) was 3.3 percent higher for Lot 1 and 7.2 percent higher for Lot 2 than for Lot 3.

The average egg production per pullet was 15.9 percent higher for Lot 1 and 8.6 percent higher for Lot 2 than for Lot 3.

Lot 1 consumed 19 percent and Lot 2, 15 percent more feed per dozen eggs than Lot 3.

The value of eggs less cost of feed per pullet, at prices used in this bulletin, was $2.22, $2.16 and $2.11 for Lots 1, 2 and 3, respectively.

The second year's production may influence to some extent the relative profitableness of these hens. This experiment will need to be repeated before conclusive results can be secured.

COMPARISON OF CORN AND WHEAT

Experiment VI*a*.—This experiment was begun October 31, 1915, with S. C. White Leghorn pullets and continued for 364 days.

The mortality in Lot 1, which received a ration containing 81.5 percent of corn, was 8 percent, while the mortality in Lot 2, fed a ration containing 81.5 percent of wheat, was 52 percent.

The average feed consumption per pullet was almost the same for each lot.

The average egg production per pullet was 6.9 percent higher for Lot 2 than for Lot 1. The total egg production for the lot, however, was 9.7 percent higher for Lot 1 than for Lot 2.

Lot 1 consumed 6.2 percent more feed per dozen eggs than Lot 2. The cost of feed per dozen eggs, at the prices used, was 30.3 percent higher for Lot 2 than for Lot 1.

The value of eggs less cost of feed was $1 per pullet for Lot 1 and 69 cents per pullet for Lot 2.

Experiment VI*b*.—This experiment was begun November 26, 1916, and continued for 364 days. S. C. White Leghorn pullets were used. Lot 4 was fed the same ration as Lot 1 beginning May 13. The results on a percentage basis, with Lot 1 as a standard for comparison, are given in Table 54. The results are presented for two periods to correspond with the change of ration for Lot 4. The results secured with Lots 1, 2 and 3 during the year are shown in the third division of the table.

TABLE 54.—SUMMARY OF RESULTS ON PERCENTAGE BASIS

Lot	Percentage in ration		Percentage of mortality	Feed consumed per pullet	Eggs produced per pullet	Feed consumed per dozen eggs	Value of eggs less cost of feed per pullet
	Corn	Wheat					
Nov. 26, 1916—May 12, 1917 (168 days)							
1	81.5	.....	...(*).....	100.0	100.0	100.0	100.0
2	54.3	27.2	100	104.7	100.4	104.4	89.0
3	27.2	54.3	100	103.8	101.4	102.3	84.6
4	.....	81.5	2100	96.0	63.1	152.3	25.3
May 13—Nov. 24, 1917 (196 days)							
1	81.5	.....	100.0	100.0	100.0	100.0	100.0
2	54.3	27.2	102.5	100.0	78.5	127.5	28.9
3	27.2	54.3	357.5	92.4	69.1	133.9	6.7
4	81.5	.....	85.0	94.8	77.3	122.6	55.6
Nov. 26, 1816—Nov. 24, 1917 (364 days)							
1	81.5	.....	100	100.0	100.0	100.0	100.0
2	54.3	27.2	150	102.4	91.5	112.1	70.1
3	27.2	54.3	350	98.4	88.9	110.8	59.9

*Lot 2 used as standard for comparison.

On the basis of results secured in this experiment it is recommended that no wheat should be used in rations for laying hens especially at this time when there is such a great need for all available wheat for human food, and at no time unless there is an overproduction of wheat and it is worth less per pound than corn.

All experiments except the comparison of range and confinement are being continued.

APPENDIX

RESULTS WITH A 200-HEN FLOCK

In order to give some idea of the results that may be expected with hens in larger flocks than can be used in our experimental work, the following data secured with a flock of 200 hens at the Clermont County Experiment Farm in southwestern Ohio are appended.

Duration.—These data were secured from October 28, 1915, to October 5, 1917, a period of 709 days. The data are presented for two periods: one of 364 days, October 28, 1915, to October 25, 1916; the other of 345 days, October 26, 1916, to October 5, 1917.

Description of fowls.—The fowls were S. C. White Leghorns hatched in April and early May and reared by a local farmer. They were moved to the Clermont County Experiment Farm September 29, 1915. They began laying November 1.

Quarters.—They were housed in one lot in a building of the half-monitor type, 24 by 34 feet in size, and had access to practically unlimited range. A small grove and some fruit trees provided shade for the flock on the range. They were confined to the house only when there was snow on the ground.

Ration.—The ration used in Experiment I*b*, described on page 201 of this bulletin, was used for this flock.

Results.—Table 55 gives a summary of the results secured with this flock.

TABLE 55.—RESULTS SECURED WITH A 200-HEN FLOCK

Average number in flock	Mortality	Feed consumed per hen			Average eggs per hen	Feed consumed per dozen eggs	Value of eggs less cost of feed per hen*
		Grain	Mash	Total			
Oct. 28, 1915—Oct. 25, 1916 (364 days)							
191.1	*Percent* 7.04	*Pounds* 40.19	*Pounds* 16.25	*Pounds* 56.44	133.4	*Pounds* 5.08	*Dollars* 2.00
Oct. 26, 1916—Oct. 5, 1917 (345 days)							
176.5	9.29	37.99	18.88	56.87	103.5	6.59	1.17
Summary: Oct. 28, 1915—Oct. 5, 1917 (709 days)							
184.0	15.58	78.18	34.98	113.16	237.8	5.71	3.20

*See page 199 for prices used in calculations.